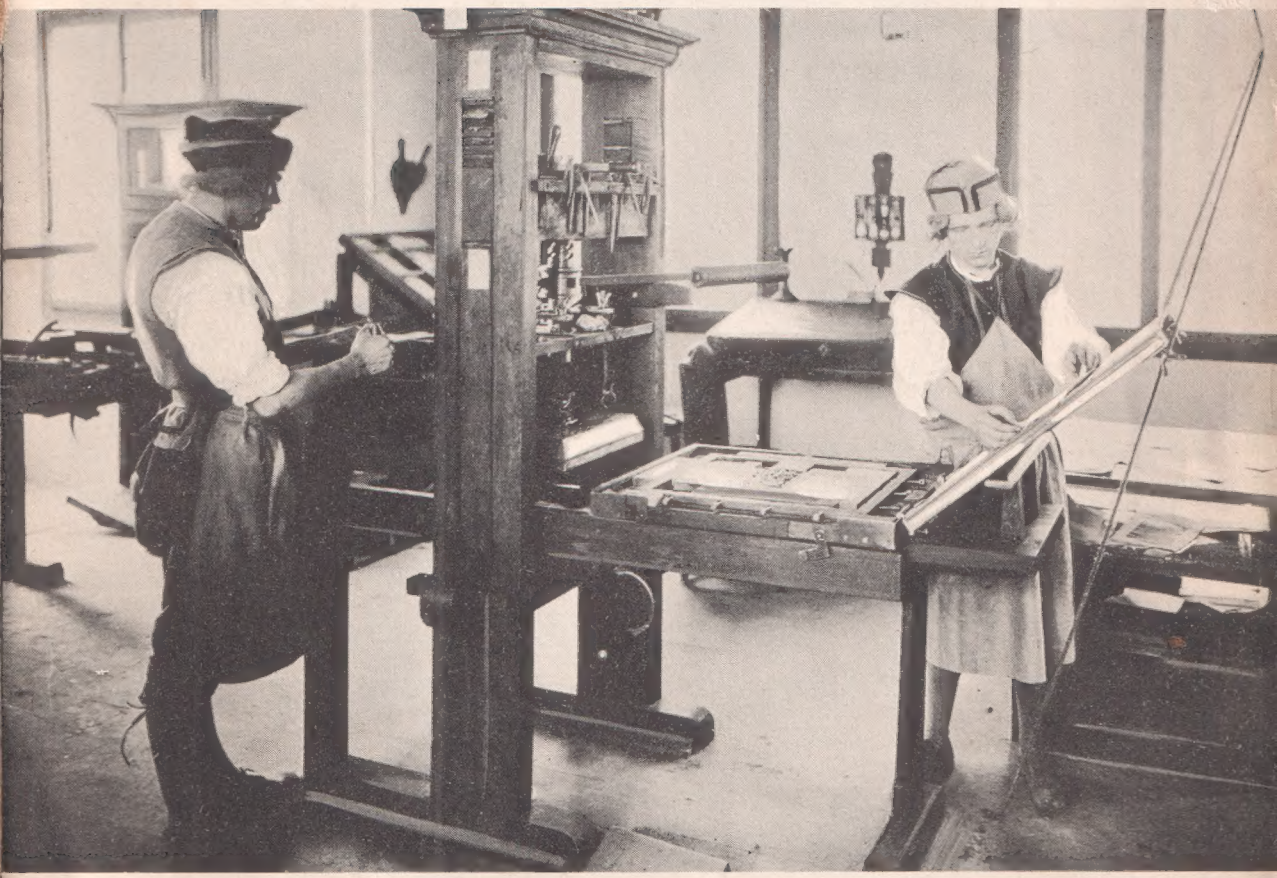
PAPER

1087

PAPER

By

Alice Martin



EWING GALLOWAY

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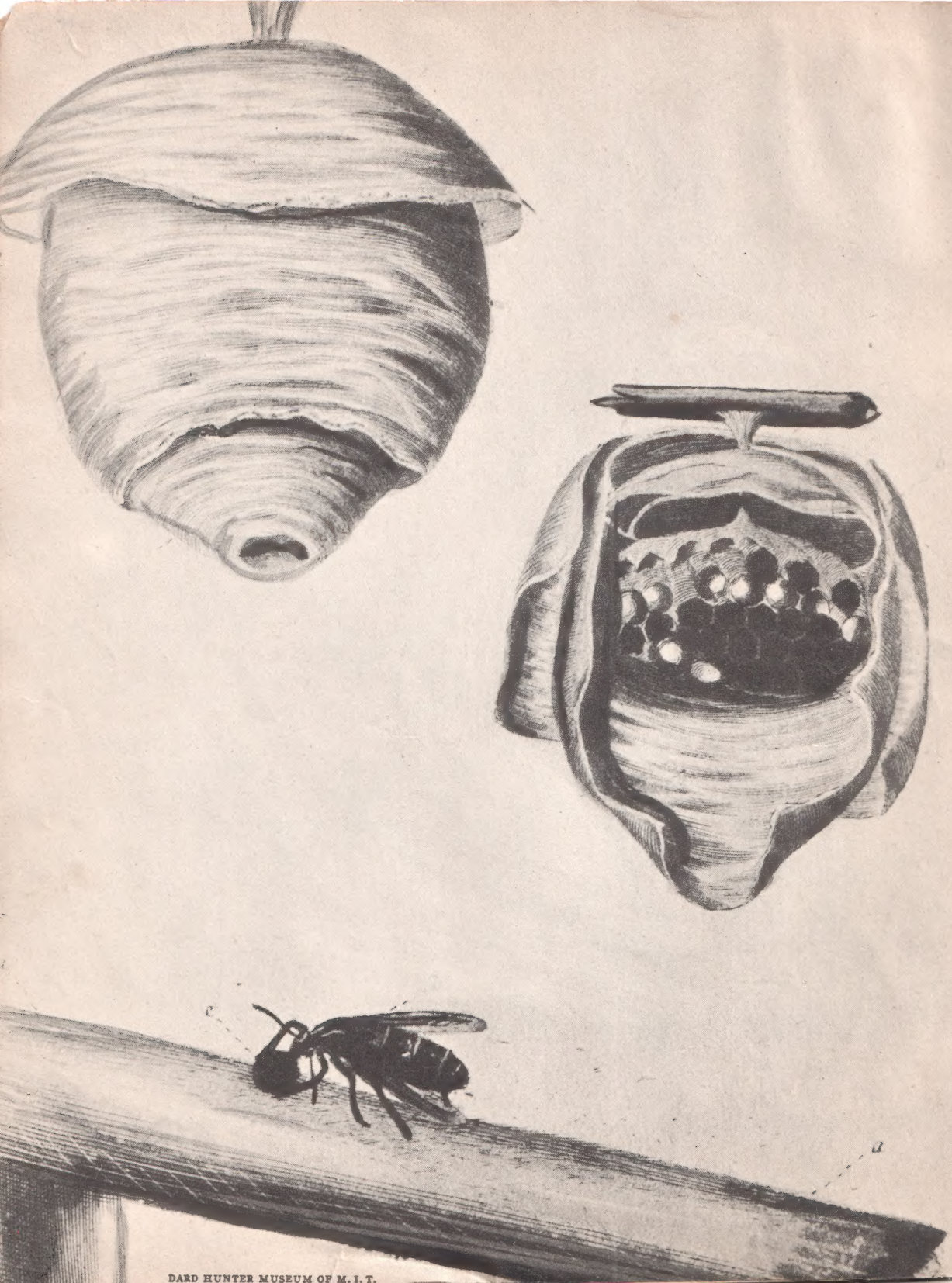


DARD HUNTER MUSEUM OF M. I. T.

NEENAH PAPER CO.

Beaten and bleached cotton fibers

Identical beaten and bleached wood fibers

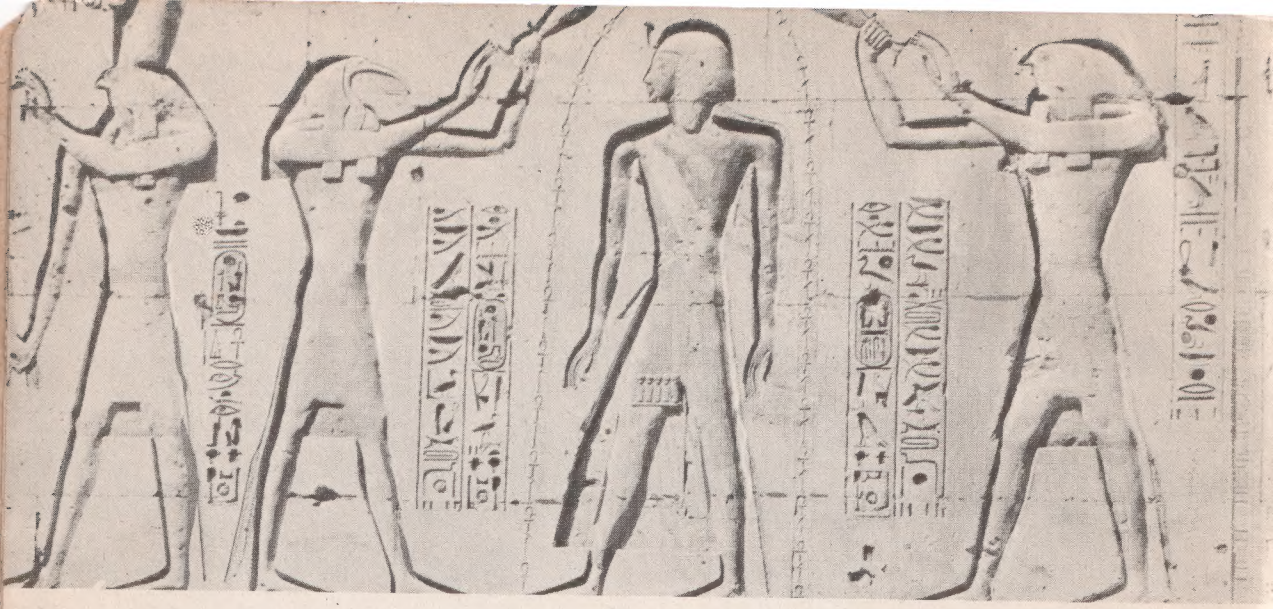
• PAPER •

THIS book was made out of bits of wood. "But it is paper," you are probably saying to yourself. It *is* paper, but the paper was made of wood. Before the wood could be made into paper, it had to be cut or ground into tiny bits.

Paper can be made of many things besides wood. It can be made of cotton or linen or jute. It can be made of cornstalks or sugar cane or grass. It can be made of straw or bamboo. It can even be made of turnips or spinach. By far the largest part of the paper used in the world, however, is made of wood.

People are not the only papermakers. For many centuries hornets have made their nests of paper. To make the paper for their nests they first chew up wood into pulp. Then they spread the pulp out in a thin layer to dry.

People were very slow to learn the lesson the hornets could have taught them. They did not learn how to make paper out of wood until about a hundred years ago. They knew how to make paper out of linen and cotton rags long before they knew how to make it out of wood. Of course, there was a time when they did not know how to make paper at all.



EWING GALLOWAY

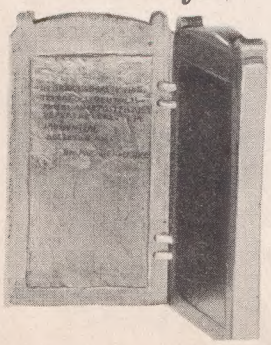
Egyptian writing on stone

Before the Days of Paper

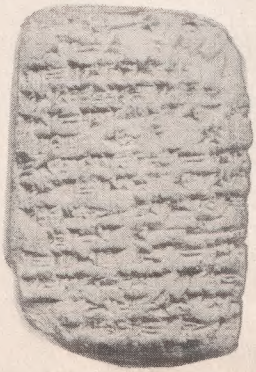
People learned to write long before they had any paper. Many of the earliest writers wrote on stone. They wrote with a sharp stone or with a hammer and chisel. Some of their writings can still be read.

Clay was another early writing material. A writer first made a pat, or tablet, of clay. He wrote on the clay with a sharp stick. Then he put the clay tablet out in the sun or in an oven to bake. The clay tablet became so hard that it would last for a long time. We have learned a great deal about some of the peoples of long ago by reading clay tablets.

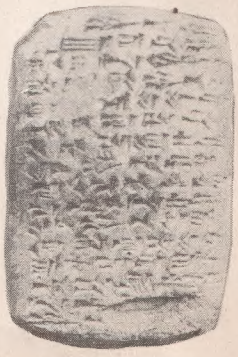
Bones, leaves of trees, pieces of bark, pieces of leather, flat pieces of metal, flat pieces of wood, and tablets of wood covered with wax were also used before the days of paper. Some of these writing materials were better than paper in some ways. They were not so good as paper in other ways.



NEW YORK TIMES



METROPOLITAN MUSEUM OF ART



METROPOLITAN MUSEUM OF ART

METROPOLITAN MUSEUM OF ART

A papyrus roll

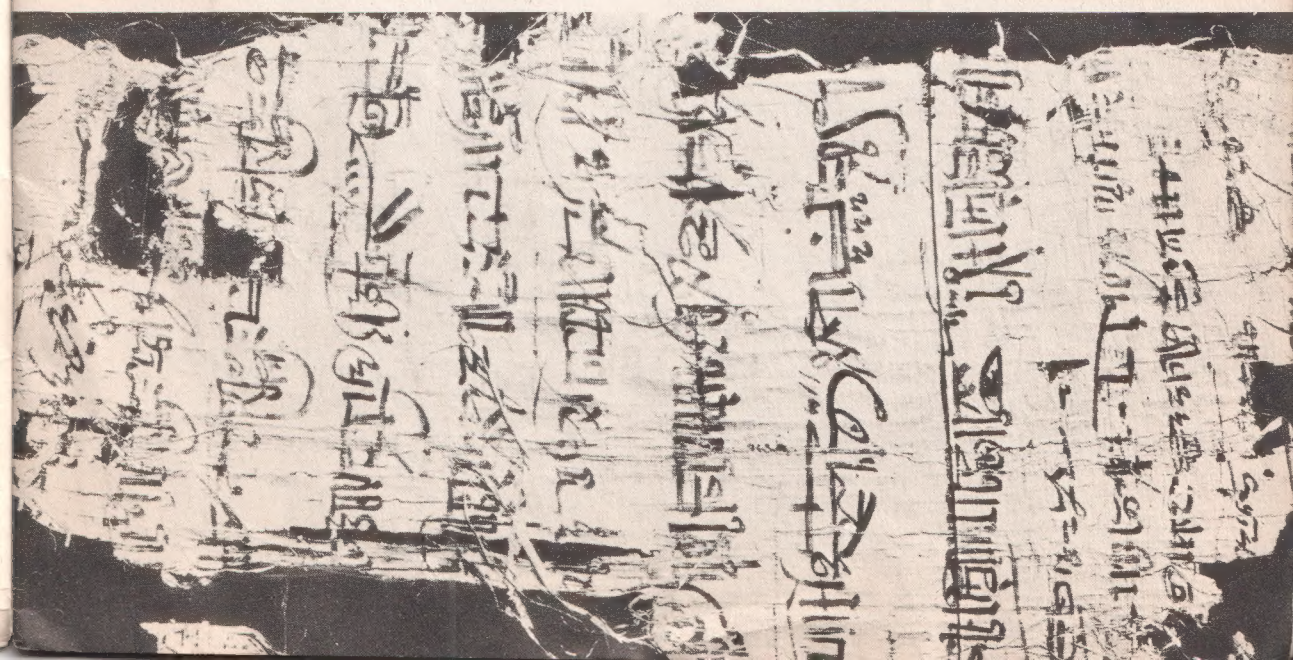
One of the best writing materials of long ago was papyrus. Do you notice that the words "paper" and "papyrus" are much alike? Papyrus looks somewhat like paper.

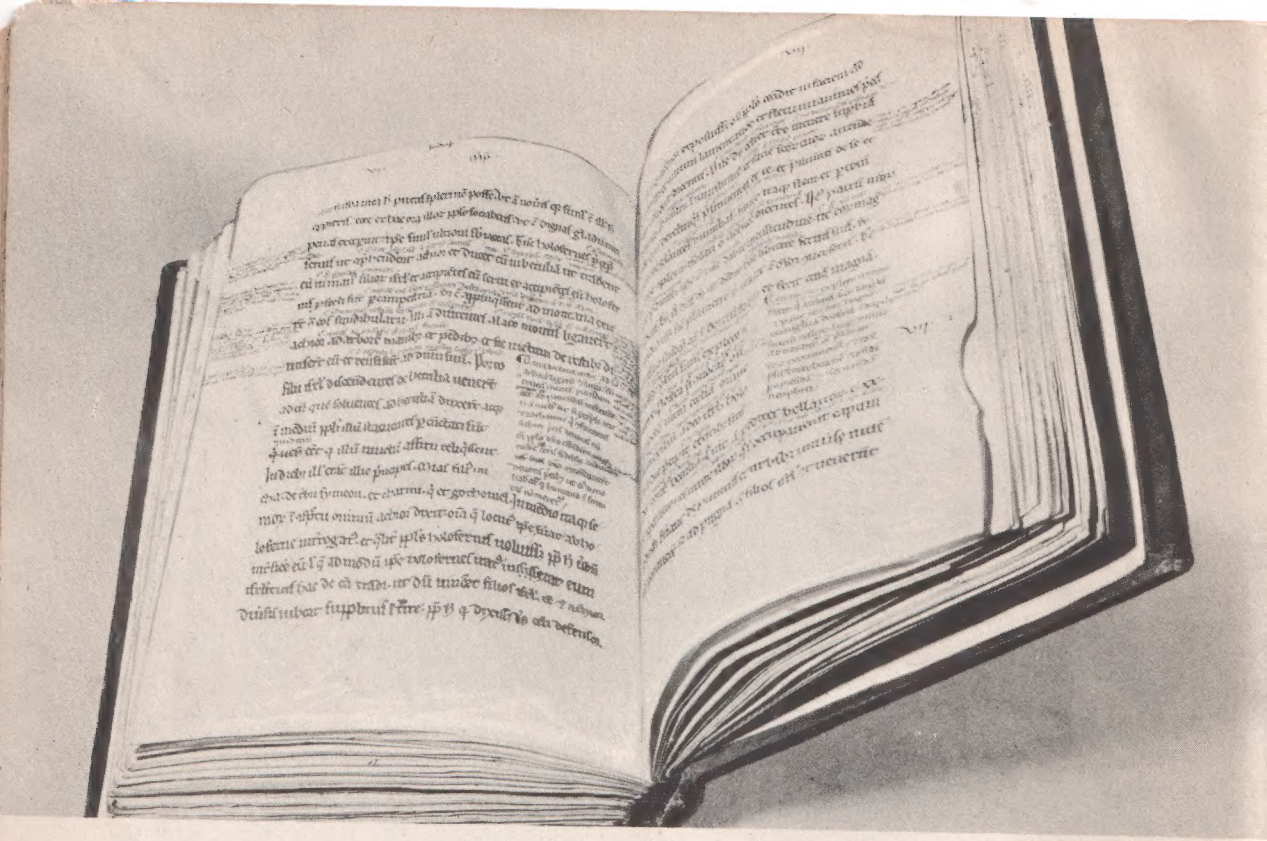
Papyrus was made from the papyrus plant. This plant once grew in great masses along the banks of the Nile River in Egypt. The papyrus plant has soft pith inside its stem. To make papyrus the Egyptians cut strips of this pith and pressed the strips together into sheets.

Papyrus could not be made into books like ours. It was too brittle. Instead, it was made into roll books. A papyrus roll book was a long strip of papyrus wound around a rod of wood or ivory.

A sheet of papyrus covered with Egyptian writing

EWING GALLOWAY





NEW YORK TIMES

A parchment book made about 800 years ago

An old story tells that a little more than two thousand years ago the king of Pergamum wanted a big library full of books. He tried to get papyrus for the books from Egypt, but the ruler of Egypt asked too high a price. The king of Pergamum then told his workers to hunt for some other material. Soon they invented parchment. They made parchment out of the skins of animals. The skins they used were mostly sheepskins, goatskins, and calfskins.

Part of this story of parchment may not be true. But at least the people of Pergamum did find out how to make parchment more than two thousand years ago.

Parchment was a good writing material, but it was expensive. Some of the most beautiful books ever made were made of parchment, but we would not have very many books today if we had to make them of such expensive material.

PIERPONT MORGAN LIBRARY

A parchment roll book

EWING GALLOWAY

Wetting bark to be made into paper

The First Paper

The first paper was made by the Chinese. It was made about eighteen hundred years ago. Before that time the Chinese did most of their writing on silk or bamboo.

The Chinese may have got the idea of making paper by accident. The women of China often washed their clothes in pools. When they rubbed the clothes, they rubbed off little threads, or fibers. Perhaps some of these fibers were washed up onto a rock at the edge of the pool and were dried by the sun to form a thin sheet—a sheet of paper. At least, the Chinese found out that tiny fibers from rags can be made into paper. They found out that fibers from the bark of the mulberry tree can be made into paper, too.

Of course, the first paper was made by hand. The rags or pieces of bark were cut up into very small pieces. They were soaked and beaten and mashed until the tiny threads, or fibers, were separated from one another. The fibers were then mixed with a great deal of water. A mixture of fibers and water is called "pulp."

For the next step in papermaking a mold was needed. A mold for making paper was a screen with a frame around it. A layer of pulp was spread over the bottom of the mold. A little pulp might be poured into the mold, or the mold might be used to dip up some pulp.

The mold was shaken this way and that. Shaking the mold helped make the fibers mat together. Some of the water in the pulp dripped through the holes in the screen. When the fibers were matted together into a sheet, the sheet was taken out of the mold on a piece of cloth. It was still very wet.

When a big pile of sheets of paper had been made, some of the water was squeezed out of them with a press. Then the sheets of paper were hung up to dry.

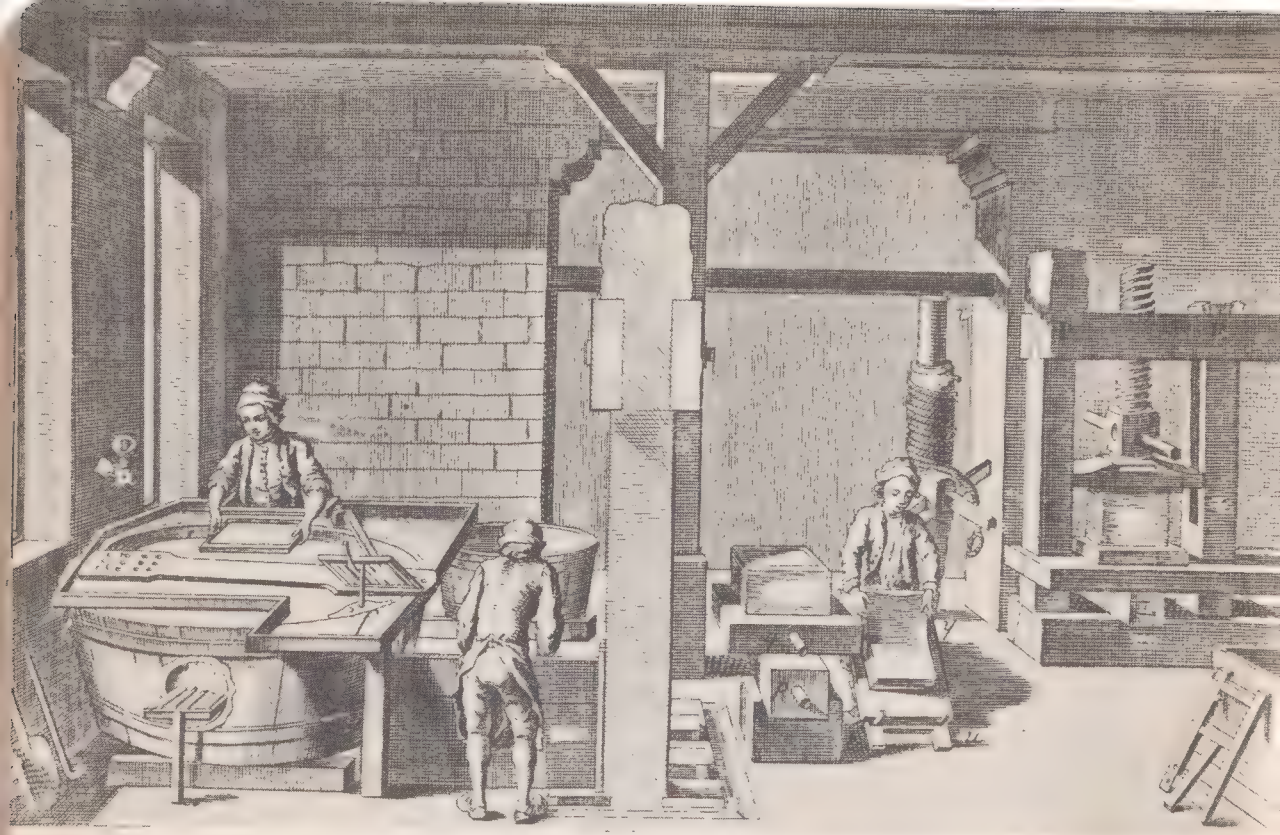
The Chinese kept their way of making paper a secret for several hundred years. In the year 704 some Arabs captured the Chinese city of Samarkand. They found a paper factory in Samarkand, and they learned how to make paper. Soon the Arabs were making good paper out of cotton and linen rags.

The art of papermaking spread to Egypt. There paper began to take the place of papyrus.

Papermaking spread from Egypt across northern Africa into Spain. Then it spread slowly northward through Europe. When printing was invented about five hundred years ago, paper was being made in many parts of Europe. It was ready to be used by the first printers.

Chinese making paper by hand

EWING GALLOWAY



BETTMANN ARCHIVE

Making paper 200 years ago

Papermaking came to America in 1690, but for many years paper was scarce here. It was so scarce that, if a papermaker tore a sheet he had made, he mended it carefully. Probably the first papermakers of our country did not dream that one day great mills would be built which would turn our forests into paper at the rate of thousands of tons a day. Probably they did not guess that our country would come to be the leading papermaking country of the world.

A Wonderful Invention

When paper was made by hand, it had to be made one sheet at a time. Three workmen working together could not make much more than a hundred pounds in a day.

In 1799—more than a hundred years ago, you see—a Frenchman named Louis Robert built a little papermaking machine. Robert's

papermaking machine was very small. It was really only a model. It did not make separate sheets of paper. Instead, it made a long ribbon of paper. The ribbon of paper was only about as wide as tape.

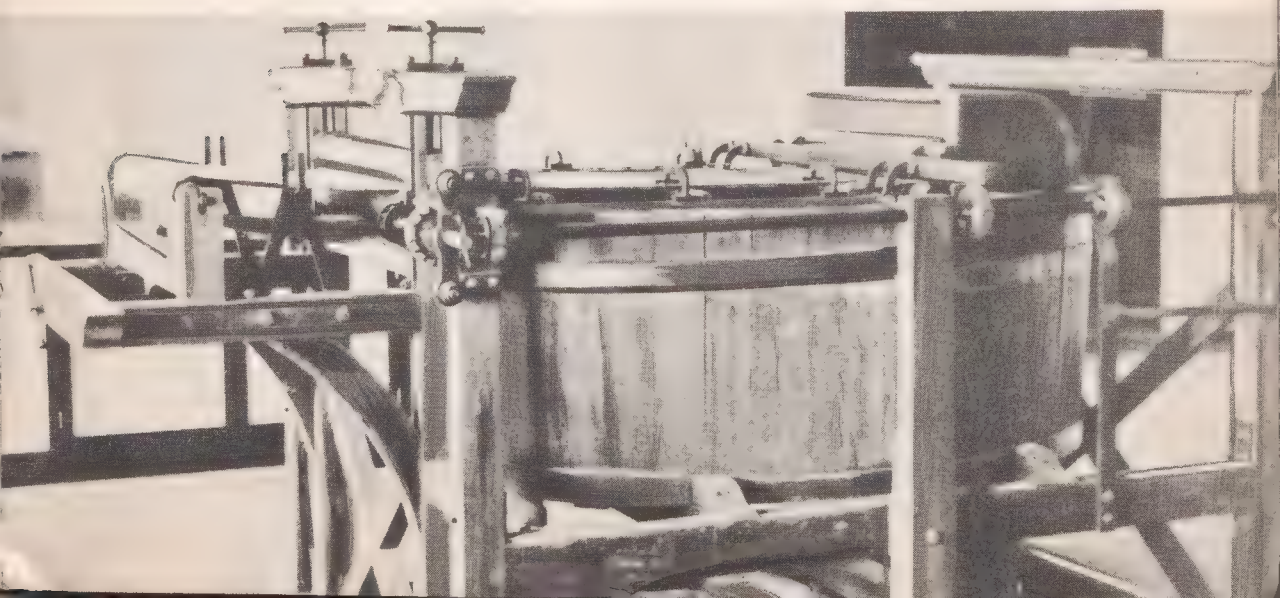
Robert believed that a big machine could be built like his little model. He thought that with a big machine strips of paper fifty feet long and twelve feet wide could be made.

Robert sold his plan for a papermaking machine. The first big machines that were made were not a success. But Robert's idea was good, and in time many papermaking machines came into use. Paper could be made on these machines much more cheaply that it could be made by hand. This little book could never have been made and sold for five cents if a papermaking machine had not been invented. Now only very fine paper is handmade.

The commonest kind of papermaking machine today—the one based on Robert's idea—is called the Fourdrinier machine. Louis Robert would certainly be surprised if he could see one of the great papermaking machines of today. Some of these machines make paper far faster than he had any idea it could ever be made. One big machine makes strips of paper more than twenty feet wide. It can make more than a mile of paper of this width in five minutes. It takes the timber from about six thousand acres to feed this big machine for one year!

A model of the first papermaking machine

DARD HUNTER MUSEUM OF M. I. T.



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The Story of a Spruce Tree

The discovery that paper can be made of wood was a very important discovery. The wood used in papermaking is much cheaper than cotton or linen. It is much easier to get in great quantities, too.

A great deal of the paper we use today is made out of the wood of spruce trees. Spruce trees are evergreen trees. Let us follow one spruce tree and watch it become paper.

Our spruce tree is growing straight and tall in a forest in the North. It is about fifty years old. At last the day comes when it is to be cut down for the paper mill. The lumbermen cut it down. They cut off its branches so that there is nothing left but a long, straight log. Then they cut this log into logs about six feet long.

EWING GALLOWAY

Logs on their way to a paper mill

The logs are hauled to a little river near by and are dumped into it. They float down the river until they come to the paper mill.

At the paper mill the logs are taken from the water and are put on a huge pile of other logs just like them. They stay there until they are needed.

A barking machine

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Chips ready to be made into paper

When it comes their turn to be made into paper, they first go through a machine which takes off the bark. This machine leaves the logs smooth and clean.

Then the logs go through a machine which cuts them up into small chips. The chips go to a digester. A digester is a huge tank in which the

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A digester

wood is cooked with a chemical. Only the fibers in wood are wanted for making paper. The other materials in wood must be removed if the paper is to be good paper. The chemical in the digester dissolves these other materials.

The chips from our spruce tree are mixed with the chips from many other spruce trees when they go into the digester. They may be mixed with chips from other evergreen trees, too. A big digester can hold several tons of wood.

The chips are cooked for nine or ten hours. Then the digester is opened, and the pulp that has been made by the cooking is dumped out into a big tank. The pulp is then washed and washed until all the chemical is washed out.

This pulp goes to a machine called a "beater." The beater cuts the wood fibers into very short pieces. It separates them from one another, too.

A refining machine

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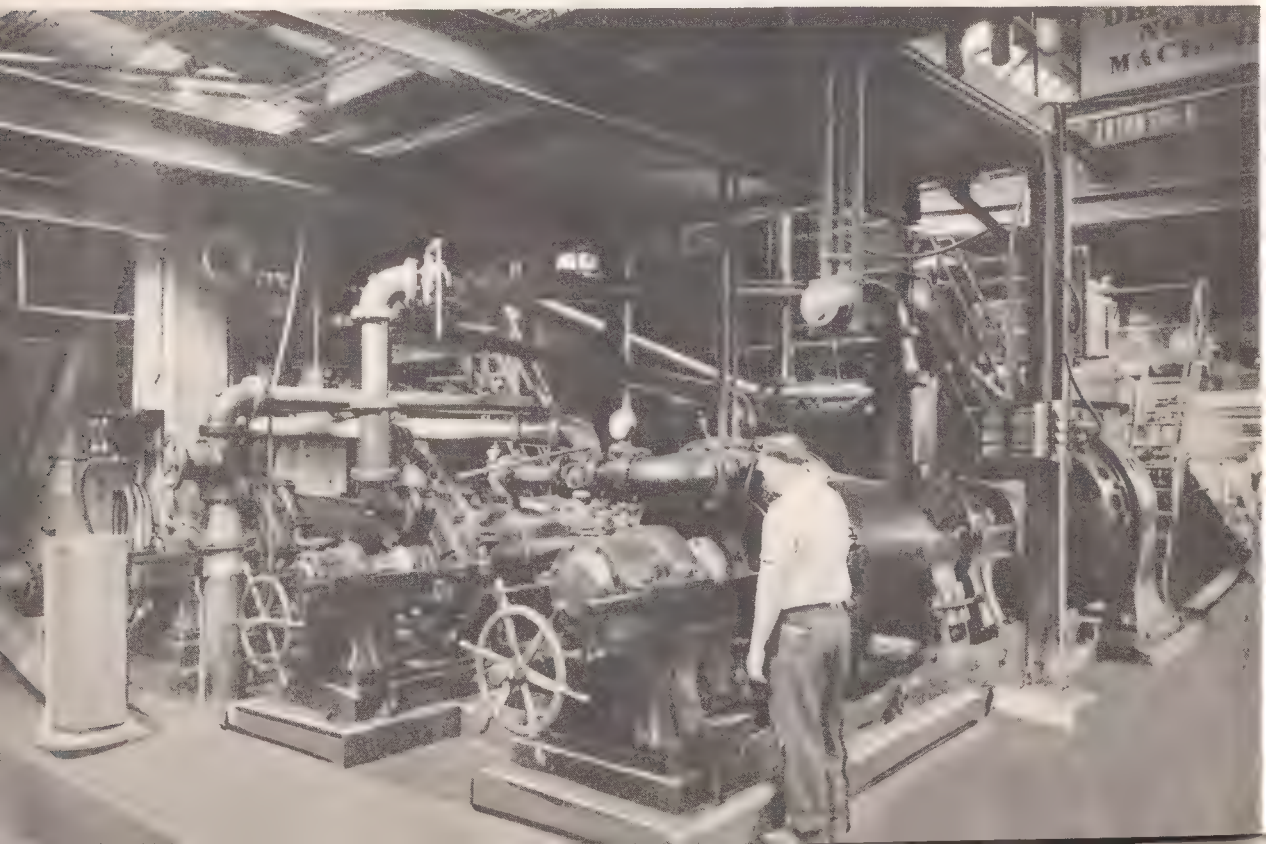

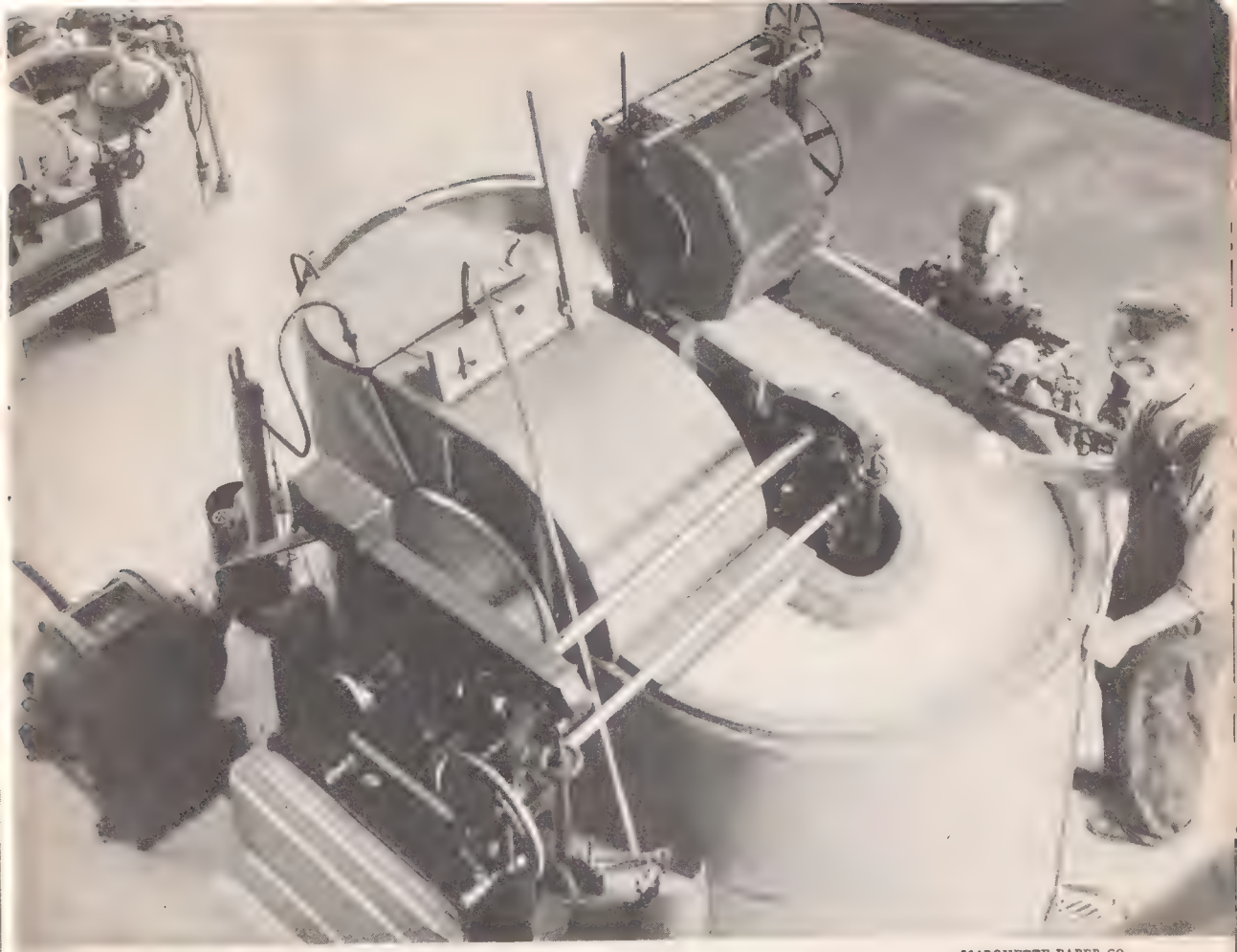

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A beater

Other materials are added to the pulp in the beater. The paper made from our spruce tree is to be smooth paper. China clay is put in with the wood pulp so that it will fill up the spaces between the fibers. The paper is to be used for printing. Another material is added which will coat the fibers and will keep the ink used in printing from soaking into them. The paper is to be bluish-white. Blue dye is added so that the paper will be the right color.

The pulp goes from the beater to another machine. This machine is called a "refining machine." In it more water is added to the pulp. If any little knots of fibers are left, the fibers in the knots are separated.

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A papermaking machine

At last the pulp is ready for the papermaking machine. About half a ton of it is poured into the huge tank at one end of the machine.

A stream of pulp flows out of the tank onto a moving screen made of wire cloth. Some of the water in the pulp drips through the holes in the wire cloth. The screen shakes from side to side as it moves. The fibers in the pulp are jolted so that they become well matted together.

At places the wire screen passes over suction boxes. These suction boxes help take water from the pulp.

When the pulp reaches the end of the wire screen, it still has a great deal of water in it, but it is paper. It is strong enough to travel a little way without resting on anything.

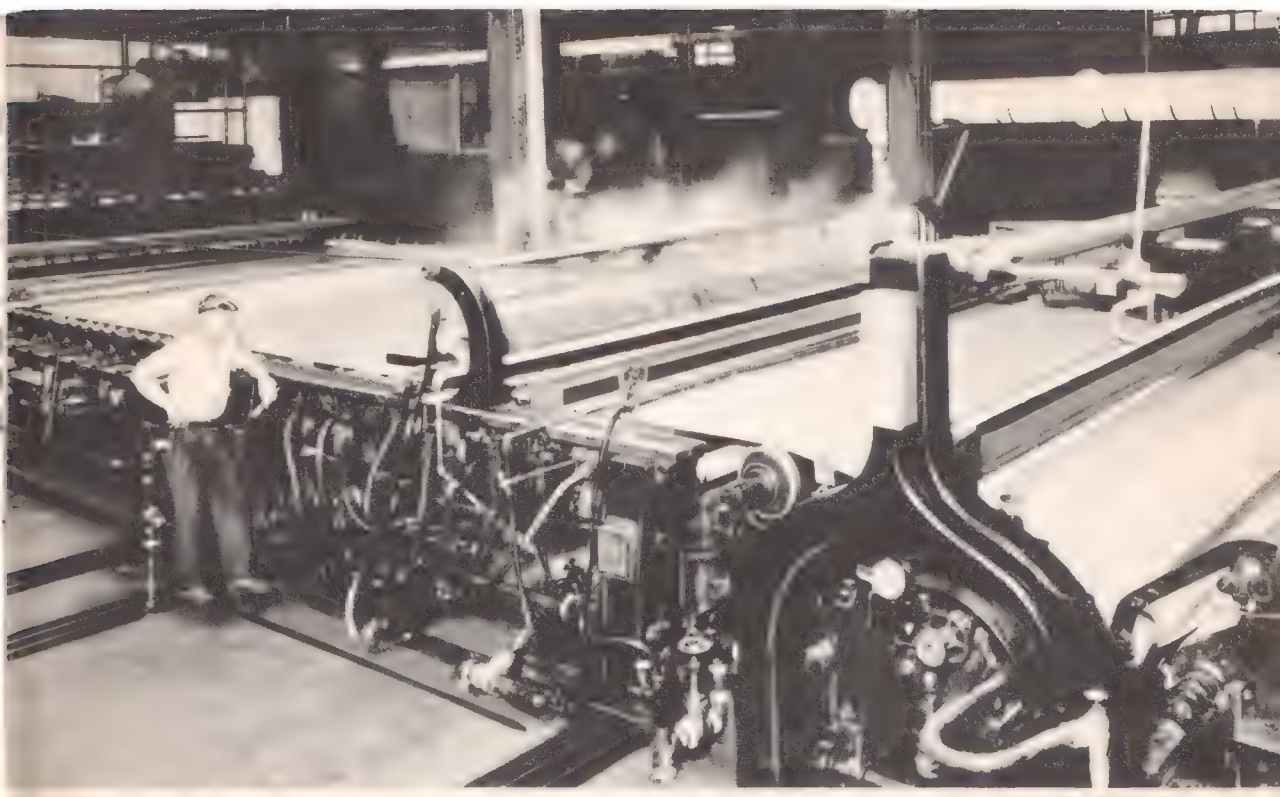
It now goes between rollers which squeeze out some of the water left in it. It travels over other suction boxes, too. But it still is very wet.

Then it travels over one big drying roll after another. The rolls are heated by steam. Coal is burned to produce the steam. It takes about a ton of coal to make a ton of paper.

By the time the paper from our spruce tree reaches the end of the machine, it is dry. Just before it leaves the machine it goes under some very heavy metal rollers. These heavy rollers make the paper smooth.

When the ribbon of paper leaves the heavy rollers, it is wound into a huge roll. This roll is so big that it is sometimes called a "jumbo roll."

The paper is then unwound from the jumbo roll. The wide ribbon of paper is cut into narrower ribbons. These narrower ribbons are wound into rolls. The paper in these rolls is smooth and white. The spruce tree is ready for the printer.



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Rolls of paper being stored

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A finishing and sorting room

Kinds of Paper

There are about seven thousand different kinds of paper. Some paper is very thin. Some is so thick that it is called "paperboard." Some paper is so soft that it tears at a touch. Some is so tough that it can be wrapped around sharp-cornered pieces of iron without tearing. Some paper lets water soak through it. Some is waterproof. Some paper is very smooth. Some is rough. Some paper is cheap. Some is expensive. Some paper lasts a long time. Some does not last long. Some paper is ready to be used as soon as it leaves the papermaking machine. Some is given a coating before it is ready to be used.

All paper is made out of fibers that come from plants. How, you may wonder, can plant fibers be made into so many different kinds of paper? Let us see.

You already know that the fibers for paper may be taken from many different kinds of plants. The paper made from one kind of plant is not like the paper made from another kind of plant.

Most paper is made out of wood, but several different kinds of wood are used. The paper made from the pine trees of the South is not like the paper made from the spruce trees of the North.

Wood must be made into pulp before it can be made into paper, but there are different ways of making it into pulp. Different kinds of wood pulp make different kinds of paper.

Even if all pulp for making paper were alike, many different kinds of paper could be made. Different materials can be added to the pulp to fill the spaces between the fibers. Different materials can be used to keep ink from soaking into the fibers. Different dyes can be added. Paper can be given coatings of many different kinds.

Different kinds of papermaking machines can be used. The machines can be run slowly or rapidly. And, of course, paper can be made by hand.

More than a third of all the paper made in our country in a year is paperboard. Some of it we call "cardboard" or "pasteboard." A great deal of the paperboard is made out of wastepaper. The same fibers, then, can be used more than once in making paper.

One of the big mills that supply us with paper

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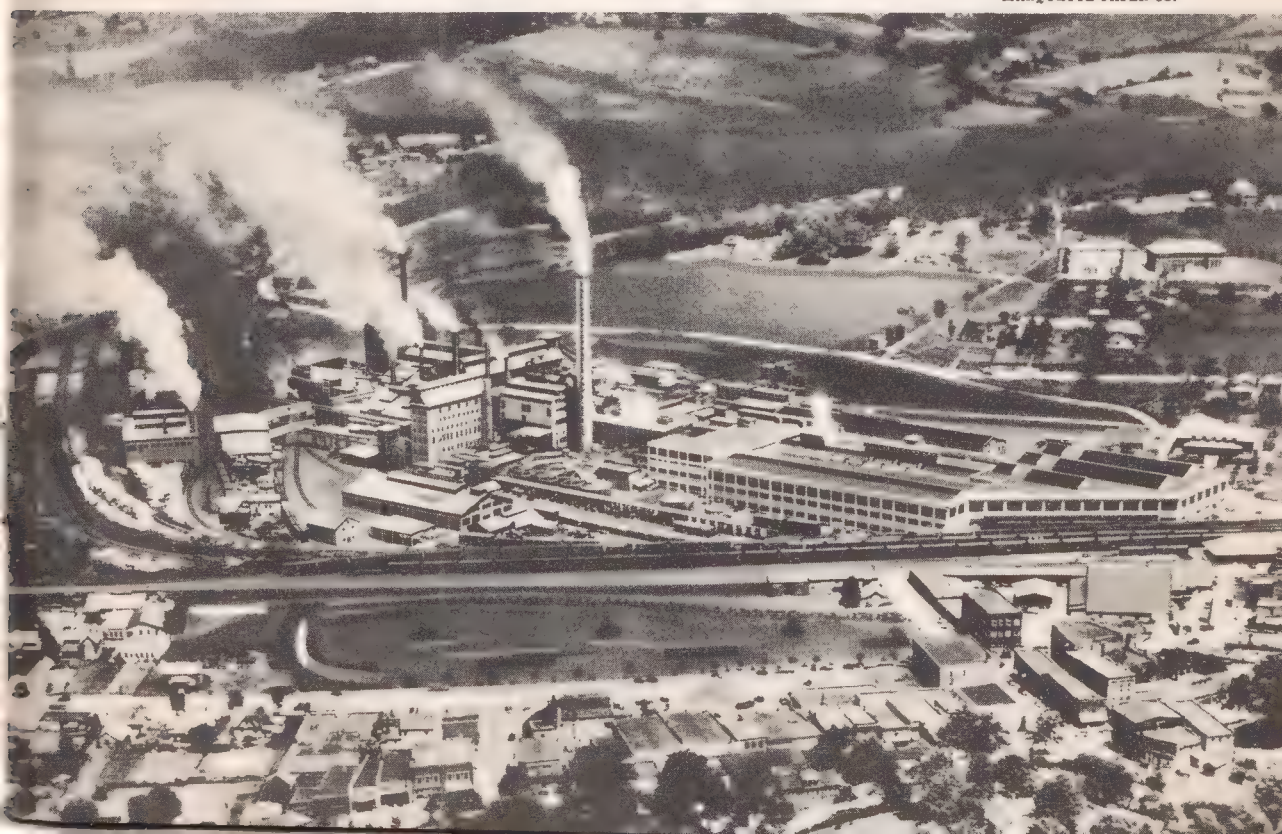

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Wastepaper bound for the paper mills

Newsprint is another very common kind of paper. Newsprint, as you can guess, is paper for newspapers. There are many different kinds of newsprint. Most of it is made of wood pulp.

Ordinary newsprint does not last long. It soon gets yellow and brittle. Sometimes people want newspapers that will last. If newspapers are to last, they must be printed on special paper. Some newspapers print a few papers on rag paper each day. Newspapers made of rag paper, of course, cost more than ordinary newspapers.

Wrapping paper, book paper, and writing paper are other common kinds of paper. Old rope, old cloth sacks, and wastepaper often go along with wood pulp into heavy brown wrapping paper. Book paper is made chiefly of wood pulp. Writing paper may be made of wood pulp. The finest writing papers are made by hand out of linen rags.

Tissue paper, wallpaper, blotting paper, and heavy paper for roofing are a few of the many other kinds of paper. The paper for paper money is still another kind.

You see, then, that if you were going to print books or make boxes or publish a magazine or make paper bags or make anything at all out of paper, you would not just order paper from a papermaker. You would order the one of the thousands of kinds of paper which would serve your purposes best.

The Amount of Paper We Use

Our country uses more than half of all the paper made in the world. One of our great newspapers—the *New York Times*—uses about one hundred thousand tons of paper in a year. Some newspapers use more. If all the paper used in a year in our newspapers were made into a ribbon a mile wide, this ribbon would be long enough to go around the world nearly fifty times.

The paper you yourself use in a year may weigh more than you do. Of course, some people use more than others. The average is more than two hundred pounds a person. Do you think you use as much as that? Before you answer this question to yourself, think of all the books and magazines you have bought, of the pads of paper you have used, and of the cardboard boxes that have come to you from grocery stores and other stores. Think, too, of other ways you have used paper. You may not have used two hundred pounds of paper, but you are almost sure to have used a great deal.

A big newspaper press

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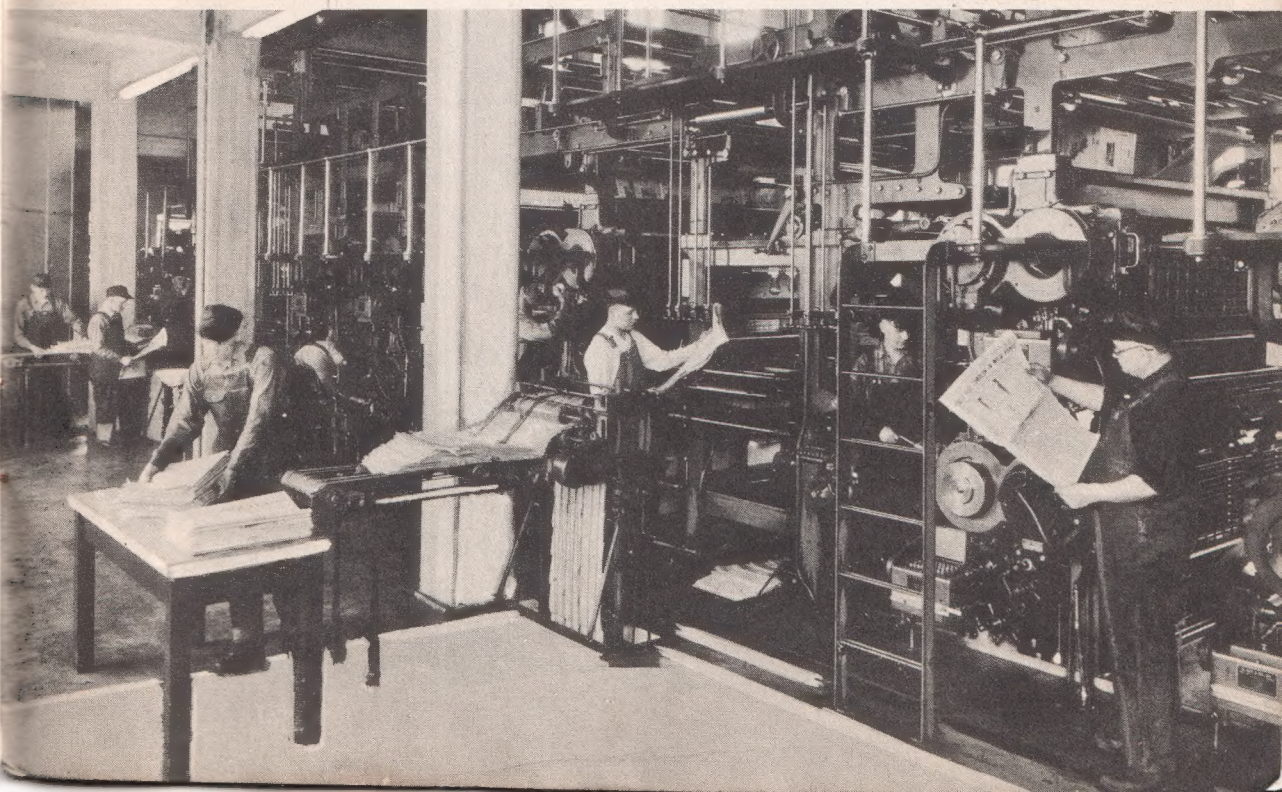
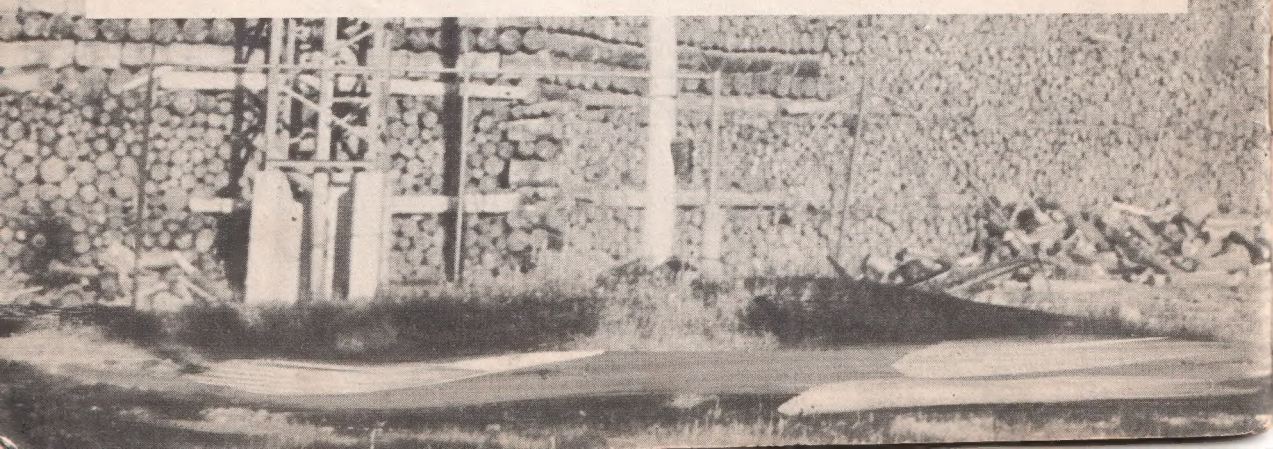


Things to Do

1. Gather samples of as many different kinds of paper as you can.
2. Show, by collecting things made of paper, as many different uses of paper as you can.
3. Tear a sheet of paper across and look at the fibers along the edge with a hand lens or a small microscope.
4. Examine an old hornets' nest to see the paper out of which it is made.
5. Make a block of modeling clay and try writing on it with a sharp stick.
6. Try writing on leather, bone, and wood.
7. Coat a flat piece of wood with paraffin and try writing on it with a sharp stick.
8. Collect pictures of writing materials which were used before the days of paper.
9. The Romans in the days of Julius Caesar had no paper. Make a list of things which you have which a Roman boy in Julius Caesar's time could not have had because there was no paper then.
10. Get a piece of filter paper from a drug store. Use a funnel and filter some muddy water through the filter paper.
11. Try to find out from some newspaper about how many tons of paper are used for that newspaper in one year.
12. Visit a paper mill if you can, and watch a paper machine at work.



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